Go East Young Man: Trends in the Ohio Utica Shale

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1. Introduction

The recent shale gas boom and widespread use of horizontal fracturing has brought much oil and gas company attention to the northern Appalachian region of the United States. The Utica Shale, which dates back 450 million years ago, in Ohio is a large area of exploration. The minerals that make up a rock affect how it breaks when subject to fracking fluids, as clays tend to bend and deform while rocks bearing more crystalline minerals, such as quartz and carbonates, fracture nicely, allowing more recovery of hydrocarbons. Total organic carbon (TOC) is a good indicator of how much oil and gas is available in a rock. This study set out to see if there is a correlation between mineralogy with a focus on clay content, TOC, and location within the Utica Shale.

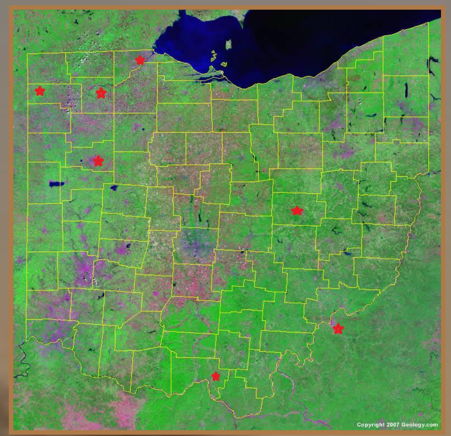


Fig 1.1 Locations of sampled wells in Ohio

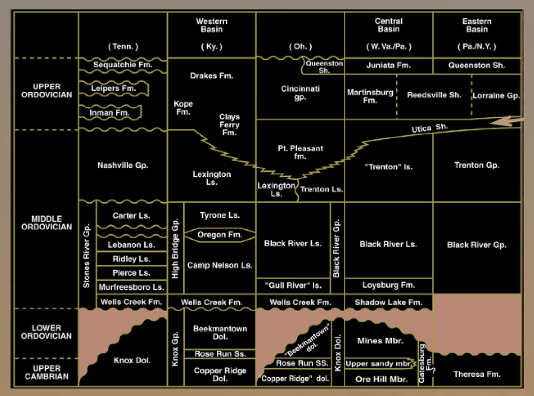


Fig 1.2 Ohio stratigraphy during the Ordovician (Wickstrom, 1992)

2. Methods

Core samples from the Ohio Department of Natural Resources were provided from various wells across the entire state. The samples provide different depths of the Utica Formation, ranging from 9564 to 1220 ft below the surface, as well as a longitudinal range from 84.7°W to 81.4°W. The counties consist of the following: Allen, Coshocton, Defiance, Henry, Lucas, Scioto, and Wood County, West Virginia. All samples were hand ground, sieved, and then put through a McCrone micronizing mill to reduce the samples to a fine powder. Two analyses were used to collect data: X-ray diffraction (XRD) and elemental analyzing (EA).

XRD: Diffraction intensity and 2-theta graphs (see below) were looked at qualitatively for mineral phases. For quantitative analysis, the Excel program Rock Jock was used.

EA: All samples were put through twice to determine total weight percent carbon. The average of the two was taken for analysis. Then, samples were treated with hydrochloric acid to remove all inorganic carbon and run through twice again to determine total organic carbon by weight percent.

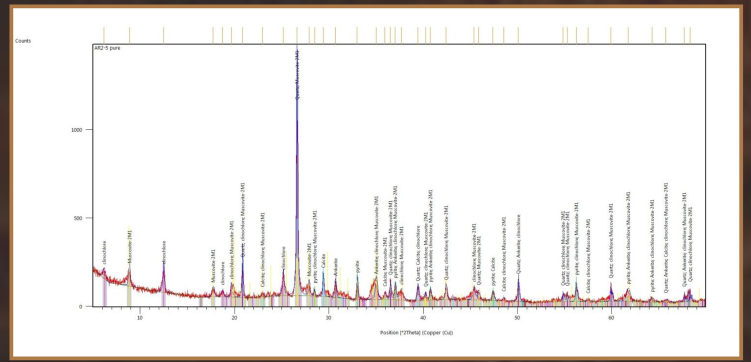


Fig 2.1 XRD pattern for a sample in the Cincinnati Group

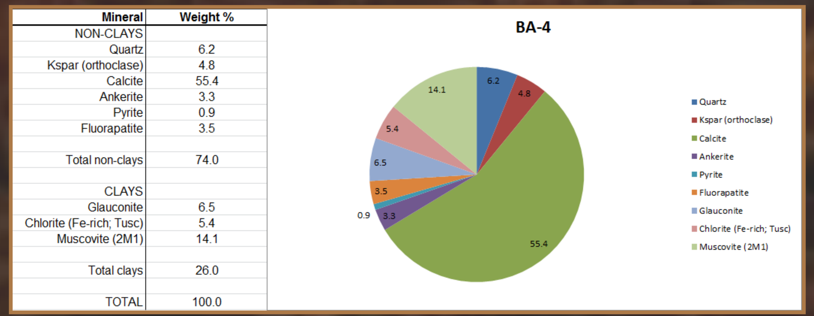
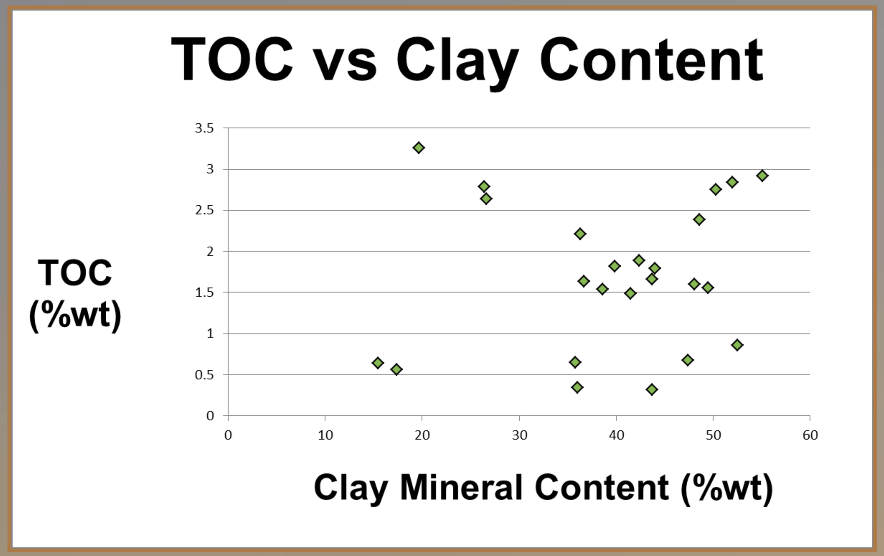
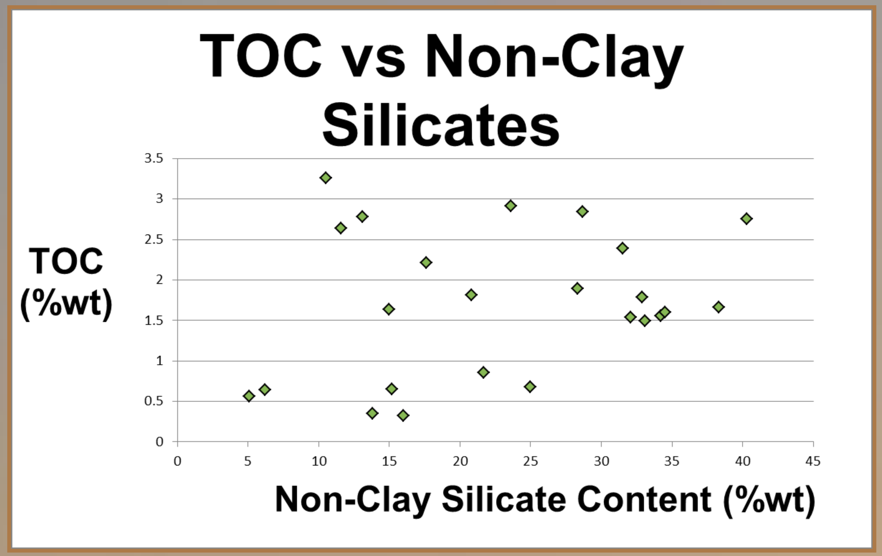


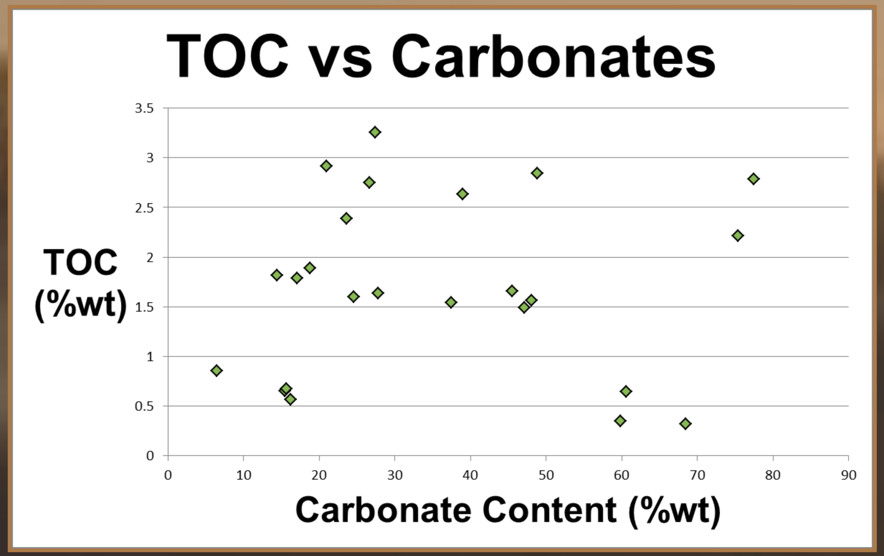
Fig 2.2 Rock Jock results for mineral quantification of a sample from the Barth well in Coshocton County

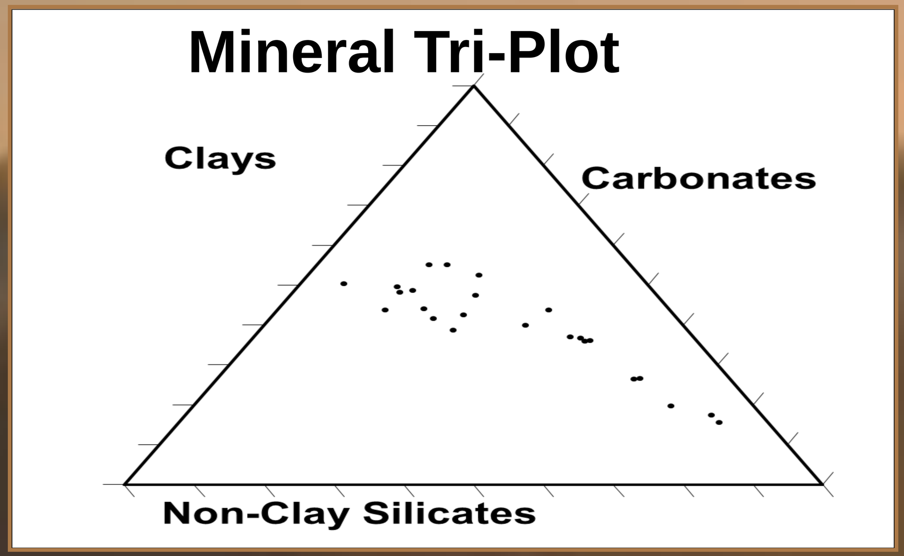
3a. Results

Mineralogy Trends

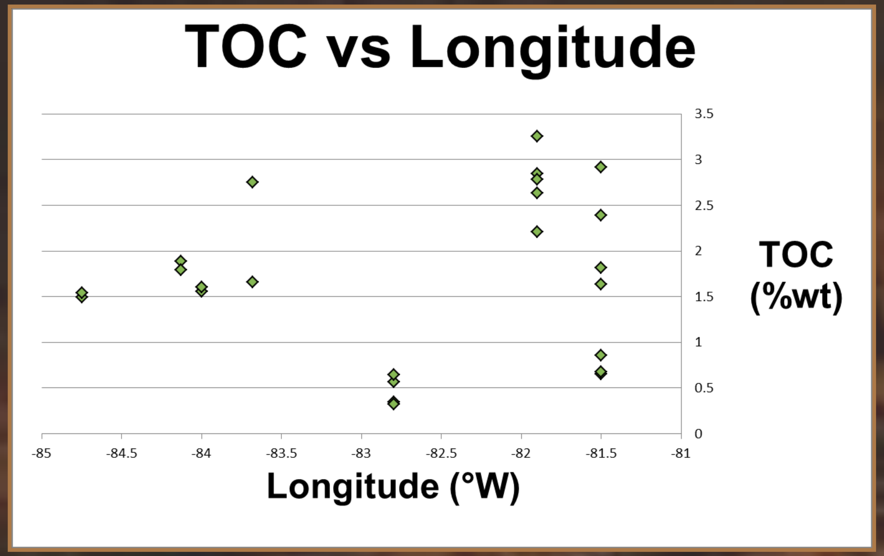


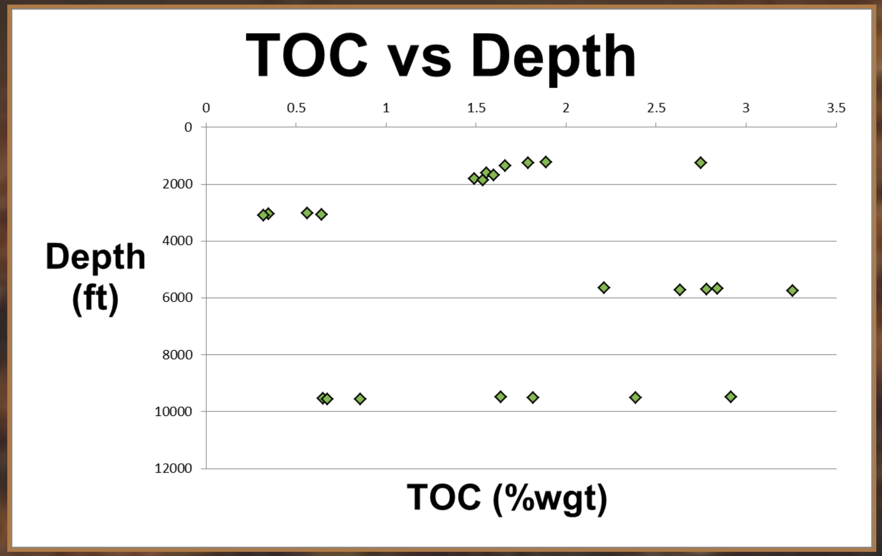


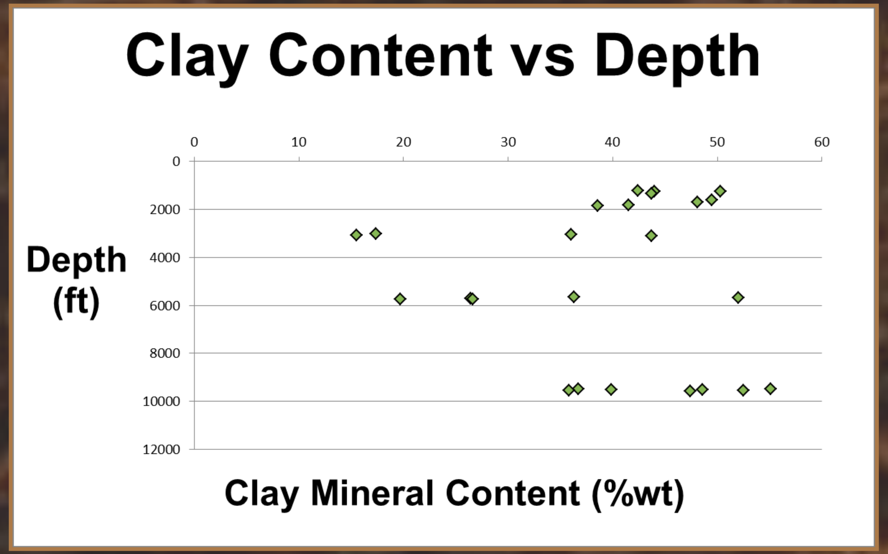




Location Trends







3b. Results

- Average TOC across all samples is 1.70%
- Higher TOC values are found in the east and at greater depths
- Average wt% of clays is 39.5%
- Average wt% of non-clay silicates is 22.9%
- Average wt% of carbonates is 36.0%

4. Conclusions

- TOC trends by location match Ohio stratigraphy and are high enough for economic pursuits.
- The amount of clay in the Utica does not appear to vary with depth
- TOC does not appear to correlate with clay content
- TOC gets lower as the amount of carbonates increase
- TOC does not appear to correlate with non-clay silicates

The correlation between TOC and the amount of carbonates is not completely consistent across the entire Utica. This shale varies greatly in its mineralogy but is promising for future studies.

5. Future Work

- Separating clays to quantify individual clay phases
- Investigate porosity and mineral associations with pores
- Finding the geologic source of clays
- Finding the source of the organic carbon content
- Applying the same techniques to a new basin

Acknowledgements

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